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ABSTRACT

The natural sciences and engineering are two of the areas of employment with low participation rates of women and minorities. This article explores as a possible cause, the rate of enrollment of these groups in mathematics and science courses in high school. Results include data showing that all females and non-Asian males take less college preparatory mathematics and high school science courses than do Caucasian males. (MP)

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PARTICIPATION RATES IN HIGH SCHOOL MATHEMATICS AND SCIENCE COURSES

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An outgrowth of the governmental requirements to identify workforces by race and sex has been the identification of certain fields of employment as having minimal participation rates of women and minorities The natural sciences and engineering are two of the areas with low participation and have received the most attention in terms of programs designed to attract women and minorities to these fields. To date, however, these programs have focussed primarily upon encouraging undergraduate students to continue graduate work. Such an emphasis would seem to be coming too late; earlier work by Sells[1] and Ernest[2] indicates that females, at least, are likely to drop out of mathematics courses at the high school level, making it unlikely that they will pursue study in the natural sciences in college. It would seem that high schools hold the key to encouraging women and minorities in the natural sciences.

In an effort to understand the choices of study chosen by college students, we analyzed the high school records of 507 freshmen* entering the University of Washington in Fall 1976 for patterns of participation in college preparatory science and mathematics courses. It is our belief that while it is not desirable that every student become a scientist, it is desirable that as many students as possible should enter college with the necessary high school courses to make possible a career choice in the sciences. It would also seem best for students

*90 Caucasian females, 129 Caucasian males, 38 Asian American females, 35 Asian American males, 46 Hispanic females, 51 Hispanic males, 62 Black females and 56 Black males.

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to have an exposure to a wide range of science courses so that they might be encouraged to pursue these fields in college; an area like physics would especially seem to need early exposure, since what a physicist does is less visible to most people than the work of a chemist or biologist.

Results of our survey are presented below in the two categories of mathematics and science courses.

Mathematics

For all ethnic groups, females dropped out of college preparatory math sequences earlier than males. (College prep math is here defined as algebra, geometry, and more advanced courses but does not include courses such as "general math.") Figure 1 shows percentages of total students continuing to the next level of math course. It can be seen that while 71% of Asian American males and 51% of Caucasian males take sufficient high school mathematics to immediately enter the calculus sequence at the University of Washington, only 14% to 37% of the other groups are so prepared. All other students would need "remedial" work before beginning a calculus sequence.

Grades were not the significant variable in determining how much math was taken. In all but one instance (Asian Americans quitting after 3 years) the average grade point of students quitting at a given level of math was higher for females than males. Furthermore, in the Caucasian and Asian American samples, there was no significant difference between the grade point average (GPA's) of females taking less than three years of math and the second year GPA's of males continuing. The GPA of Caucasian and Asian American males quitting after two years was significantly lower than ($p. < .02$) the second year GPA of females who took a third year of math. There was also a significant difference ($p. < .02$) between the GPA's of Caucasian and Asian American females quitting after two years of math and those continuing. It appears that Asian

American and Caucasian women must be superior students to continue beyond two years of college prep math, while the males need be no better than average.

For the remaining minority groups, math performance would appear to be related to earlier math training. Table I shows the percentage of students taking general or remedial math in high school. Note that all females and Hispanic and Black males are more likely to take general or remedial math.

In summary, all females and non-Asian males take less college prep math in high school than do Caucasian males. All groups take more remedial or general math than do Caucasian males, indicating that differences in participation in math courses may begin before high school. For Asian American and Caucasian females ability to perform in college prep math courses as measured by grades does not appear to explain differences in amount of math taken.

Science

High school science programs no longer predictably follow the biology, chemistry, physics sequence. Some high schools also offer advanced courses in science areas, allowing one to concentrate in a specific science area. The sequence of biology, chemistry and physics nonetheless remains important since these courses are often prerequisites to college work. Figure 2 shows percentage of students participating in the basic college preparatory science courses. Caucasian males show a steady participation rate in all three courses, Blacks show the most dramatic overall drop in participation rate, while Asian Americans and Caucasians show the greatest differences in participation between males and females. Within each ethnic group there is little difference in grade point average between females and males.

The participation rates by females and minorities in traditional high school science courses match their participation in high school mathematics courses and college study and employment in the fields of life sciences, chemistry and physics.

Insufficient mathematics training may be perceived by some as a barrier to participation in high school physics; however, a comparison of Figures 1 and 2 shows that Caucasian males, unlike all others, participate in physics at a higher rate than they do in fourth year mathematics.

High school physics has important functions: it serves as a means of exposing students to a field of study they are unlikely to simply chance upon; and it is a prerequisite to many fields of study, including, at University of Washington, for example, astronomy, chemistry, computer science, engineering, environmental health, forest resources, geological sciences, oceanography, pharmacy, and physics. Alternative science courses to the biology-chemistry-physics sequence may serve to keep students in science courses, and this can be seen as a positive outcome. In fact, in our sample, females were more likely than males to have taken a second, more specialized biology course. The problem with this pattern lies in the fact that the alternative courses do not yet seem to be accepted as prerequisite courses by universities and colleges; therefore, only those <u>not</u> serious or <u>not</u> informed about careers in the sciences, especially physical and mathematical sciences, can afford the "luxury" of the alternative courses.

Students, both male and female, minority and non-minority, should be made aware of the importance of the biology-chemistry-physics sequence in allowing free career choice in college. Teachers play an essential role in encouraging students to continue science courses. This role has been pinpointed in recent research on women in science[3,4]; most women scientists, both minority and non-minority, reported in interviews that the encouragement of a single high school science teacher was the deciding factor in their choice of a career in science. (High school counselors, on the other hand, are uniformly reported as negative influences.) High school teachers are thus in the key role to bring about the

changes in patterns of subject choices prerequisite to any change in college and career choices by women and minorities.

Table I

PERCENTAGE OF STUDENTS TAKING AT LEAST ONE REMEDIAL OR GENERAL MATH COURSE

	Female	Male
Asian American	15.8%	5.7%
Black	43.5%	42.9%
Caucasian	11.1%	5.4%
Hispanic	47.8%	34.6%

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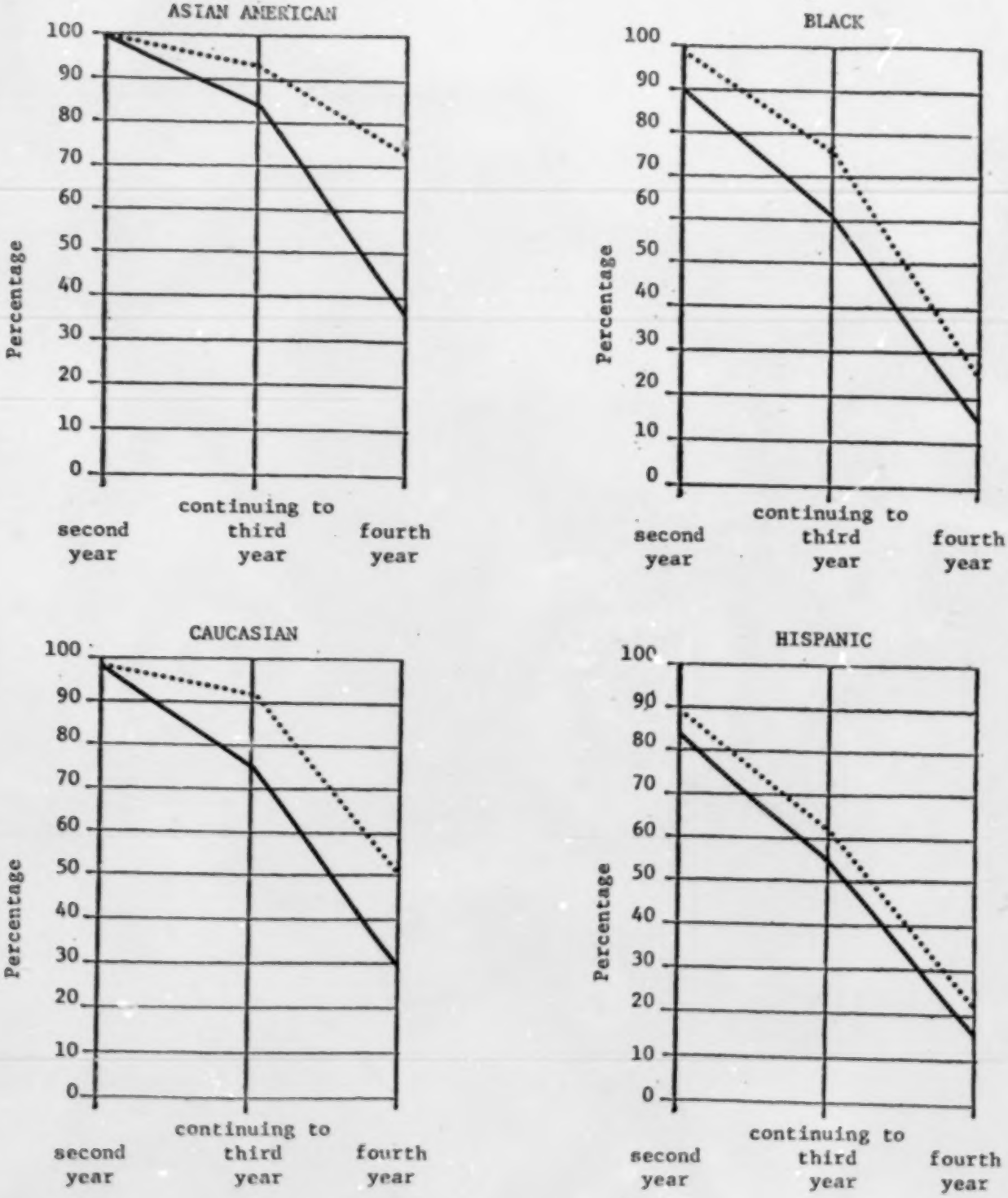
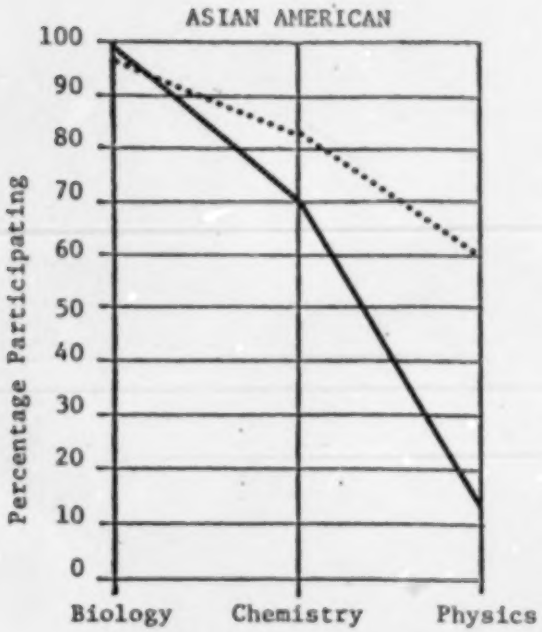
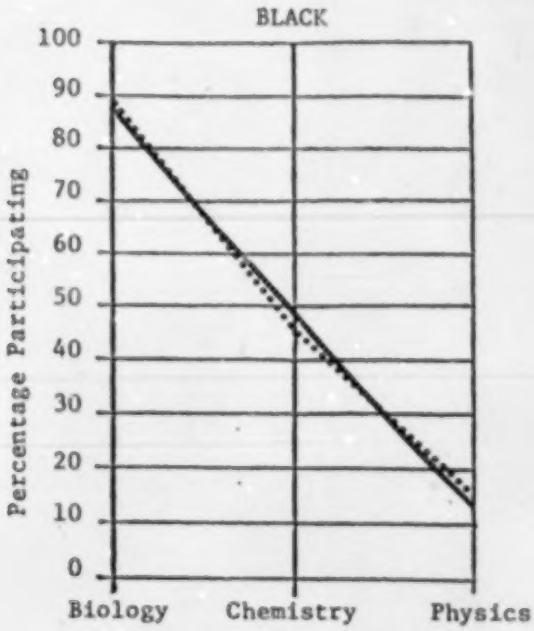
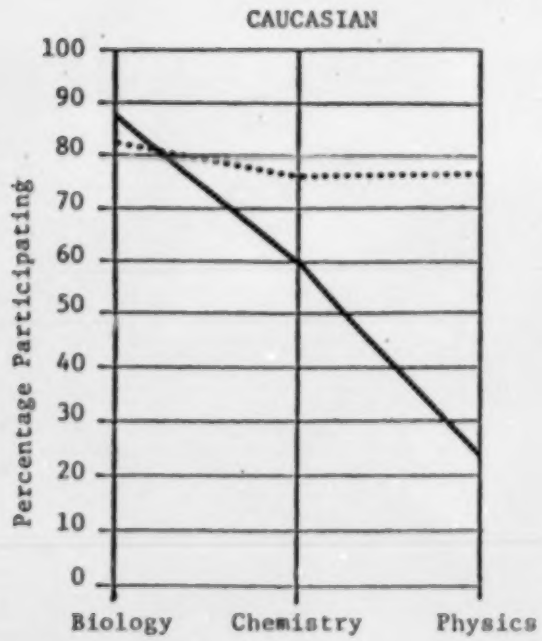


Figure 1. Percentages of students continuing to next level of college preparatory mathematics.







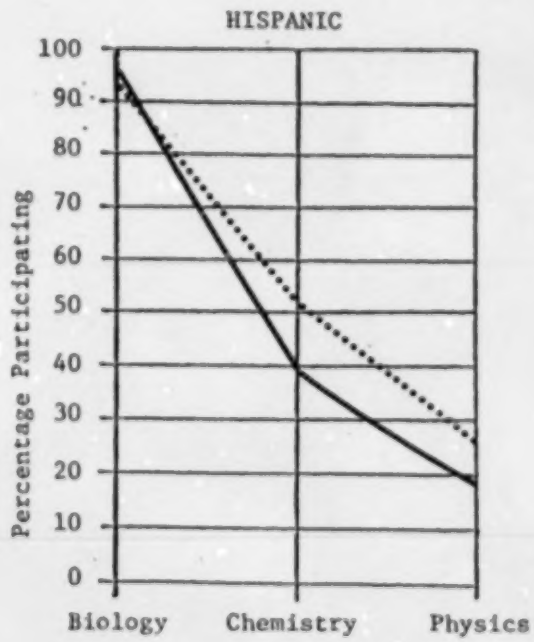


Figure 2. Participation in traditional college preparatory science courses.

Key: —— females
.... males